



**FACULTY OF ELECTRICAL ENGINEERING
AND INFORMATION SCIENCE**



**INFORMATION TECHNOLOGY AND
ELECTRICAL ENGINEERING -
DEVICES AND SYSTEMS,
MATERIALS AND TECHNOLOGIES
FOR THE FUTURE**

Startseite / Index:

<http://www.db-thueringen.de/servlets/DocumentServlet?id=12391>

Impressum

Herausgeber: Der Rektor der Technischen Universität Ilmenau
Univ.-Prof. Dr. rer. nat. habil. Peter Scharff

Redaktion: Referat Marketing und Studentische
Angelegenheiten
Andrea Schneider

Fakultät für Elektrotechnik und Informationstechnik
Susanne Jakob
Dipl.-Ing. Helge Drumm

Redaktionsschluss: 07. Juli 2006

Technische Realisierung (CD-Rom-Ausgabe):
Institut für Medientechnik an der TU Ilmenau
Dipl.-Ing. Christian Weigel
Dipl.-Ing. Marco Albrecht
Dipl.-Ing. Helge Drumm

Technische Realisierung (Online-Ausgabe):
Universitätsbibliothek Ilmenau
[ilmedia](#)
Postfach 10 05 65
98684 Ilmenau

Verlag:  Verlag ISLE, Betriebsstätte des ISLE e.V.
Werner-von-Siemens-Str. 16
98693 Ilmenau

© Technische Universität Ilmenau (Thür.) 2006

Diese Publikationen und alle in ihr enthaltenen Beiträge und Abbildungen sind urheberrechtlich geschützt. Mit Ausnahme der gesetzlich zugelassenen Fälle ist eine Verwertung ohne Einwilligung der Redaktion strafbar.

ISBN (Druckausgabe): 3-938843-15-2
ISBN (CD-Rom-Ausgabe): 3-938843-16-0

Startseite / Index:
<http://www.db-thueringen.de/servlets/DocumentServlet?id=12391>

T. Nikolov, A. Tsenov

Models of Alternative Management Architectures

ABSTRACT

Network Management is needed to control and optimize the operation of the network and to respond to changing user requirements. Management includes the initialization, monitoring and modification of the network functions. In order to perform management, special functions are needed. To distinguish these functions from the normal network functions, this work includes the terms “management functions” and “primary functions”.

Management functions may be performed explicitly by human operators, but also automatically by dedicated soft - and hardware modules. In case human operators are responsible for network management, most management functions will be per-formed from a limited number of remote locations. In case management functions are performed automatically, it is possible to distribute the hard - and software modules that implement these functions over the various systems in the network.

This work explains the proposal by the authors according new alternative management architectures based on the integration of primary functions and management functions over three levels of management – service management, protocol management and element management. As a result three models of alternative integrated architectures are introduced – one for OSI – management, one for TMN and one for Internet – management.

I. INTRODUCTION

Architectures for network management enable the designers to discuss management functions at a high level of abstraction and guide the design of management protocols and services. In this work it is assumed that architectures consist of: a set of architectural concepts; rules that tell how to use these concepts and models for designing a specific class of systems.

All current management architectures, notably the ISO, ITU-T and the IETF architectures, have been developed after the design of the network functions have been completed. Such approach indicates a specific conceptual view of the role of the management functions and invites to apply different architectural concepts for the design of management functions. This work proposes an alternative approach, in which no principle distinction is made between the management requirements and the requirements of primary functions. Both sets of requirements can be integrated into one set of requirements and elaborated in a single design process, which uses one architectural model.

To demonstrate that both kind of functions can be expressed in the architectural concepts and rules as used by the OSI – Reference model, tree models are developed – model of distributed management architecture, model of centralized management architecture and model of hybrid management architecture. A set of new definitions according to new architectures are also presented.

II. OSI MANAGEMENT, TMN MANAGEMENT AND INTERNET MANAGEMENT

The origin of OSI management can be found in ISO, most of the work is performed in collaboration with the ITU-T. The standards that results from this cooperation are published by both organizations without technical differences. Within the ITU-T, the OSI management recommendations are published as part of the X.700 series.

The first standard that describes OSI - management, is the *OSI Reference Model* [1]. This standard identifies OSI management as an important working area and provides initial definitions. The first outcome that presents the development of OSI management was the *OSI Management Framework* [2]. Later it was decided to produce an additional standard, which was called the *Systems Management Overview* [3]. These standards provide the basis for OSI management (Figure 1).

Title	ISO/IEC	ITU-T	Year
OSI Management Framework	7498/4	X.700	1989
OSI Systems management Overview	10040	X.701	1992

Fig. 1: The basis of OSI Management

The term TMN is introduced by the ITU-T as an abbreviation for Telecommunications Management Network. The concept of a TMN is defined by Recommendation M.30210 [4].

According to M.3010 “a TMN is conceptually a separate network that interfaces a telecommunications network at several different points”. The relationship between TMN and the telecommunications network that is managed is shown on Figure 2.

According to this figure, the interface points between the TMN and the telecommunications network are formed by Transmission Systems and Exchanges. They are connected via Data communication network to one or more Operations systems. The Operations systems perform most of the management functions; these functions may be carried out by human operators but also automatically. It is possible that a single management function will be performed by multiple Operations systems. In this case the Data communication network is used to exchange information between the operations systems.

In the second half of the past decade the Internet grew to a size that management of the Internet could no longer be provided on an ad hoc basis: a structured and standardized approach to Internet management was required.

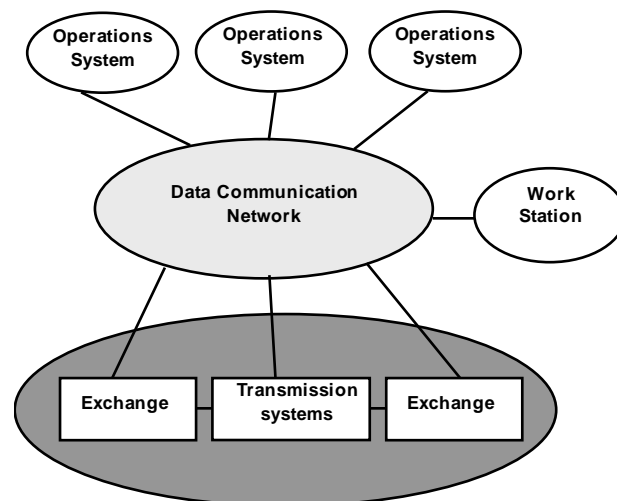


Fig. 2: General relationship of a TMN to a telecommunication network

SNMP (Simple Network Management Protocol) [5] is a further development of SGMP (Simple Gateway Management Protocol). SGMP was aimed at management of Intermediate Systems – Gateways. Because SGMP appeared to be a success, it was decided to extend its scope and include management of End System. To reflect this change, the protocol was renamed into SNMP.

It is important to say that no special standards have been defined for the Internet Management architecture; only protocols and MIB's have been standardized.

The main goals of the future enhancement of the Internet Management architecture are:

- All systems connected to the network should be manage-able with SNMP;

- The cost of adding network management to existing systems should be minimal;
- It should be relatively easy to extend the management capabilities of existing systems;
- Network management must be robust.

III. FUNCTIONAL MODEL OF ALTERNATIVE PROTOCOL MANAGEMENT

As developed in [6] the last step of the realization of the functional model of the protocol management includes the mapping of protocol interactions upon underlying services. The analysis of the results of the addition of management functions and they convey over the user services leads to specific realization, which is based on distribution of the functions of the providers into user data and management data [6, 7, 8]. On Figure 3 the resulting functional reference model of the alternative protocol management is shown.

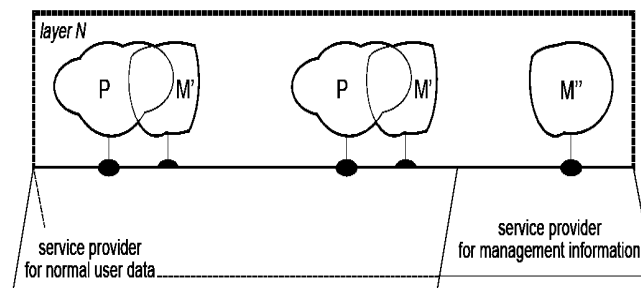


Fig. 3: Functional reference model of alternative protocol management architecture

The physical protocol reference model can be derived from the functional model by mapping functional entities upon subsystems. The special management entity M'' (Figure 3) can be implemented in different way:

- The management can be implemented together with a data entity;
- The management entity can be implemented as a separate subsystem.

The choice of a appropriate decision is made according to the management standards for the management of telecommunications systems – the management subsystem will be more reliable and efficient if it is implemented as a separate subsystem. That leads to the following physical reference model of the alternative protocol management – Figure 4.

The next step in this work is to relate both defined models – the functional and the physical reference models for protocol management to several parts of OSI, TMN and Internet management. Discussing this relationship is useful for the following reasons:

- current work on management can be placed in a better framework. As a result, the understanding of network may be improved;

- by using existing parts, the applicability of these models for protocol management can be demonstrated without having to define yet another set of management protocols and functions.

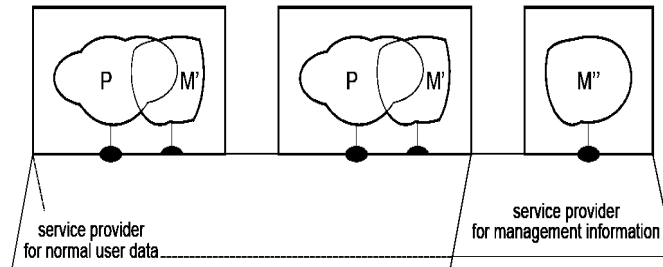


Fig. 4: Physical reference model of alternative protocol management architecture

Relationship to OSI

The models as presented in this work may be considered as alternatives or replacements of (the communication oriented parts of) the OSI Management Framework [2] and the System Management Overview [3]. Since the models of this work show how primary functions can be extended with management functions, they can also be regarded as extensions of the OSI Reference Model.

As shown in Figure 5, it is possible to relate several parts of OSI management to the functional reference model for protocol management as presented in this work. The picture shows the distribution of the roles in the common management process according to the models, earlier developed in this work.

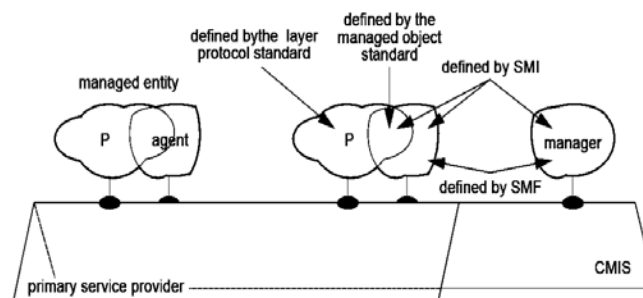


Fig. 5: Relationship to OSI management

The two managed entities together perform the primary functions (P) of the “layer protocol”. The protocol standards define a number of variables and commands, which can be used for management purposes. In terms of OSI management, these variables and commands represent the “managed object”. General rules explaining how object should be described, are defined by the SMI (Structure of Management Information). These rules should not only be known to describe managed objects, but also to interpret management information within the manager entity. The manager has to activate the

SMF (System Management Functions) in order to manipulate the generic management information defined in SMI.

The OSI management group has introduced the object oriented approach for management. In many of its management standards, this object oriented approach plays dominant role. This is the reason, why the object oriented approach is also preferred for the development of simulation tools for simulation of management actions.

Relationship to TMN

The functional and the physical models for protocol management can be used to illustrate TMN functional blocks and reference points unless there is no such term like “protocol management” in TMN. Figure 6 shows how the models developed in this work can be used for defining the model of the communications between the main functions in TMN – OSF (Operations Support Function) and NEF (Network Element Function).

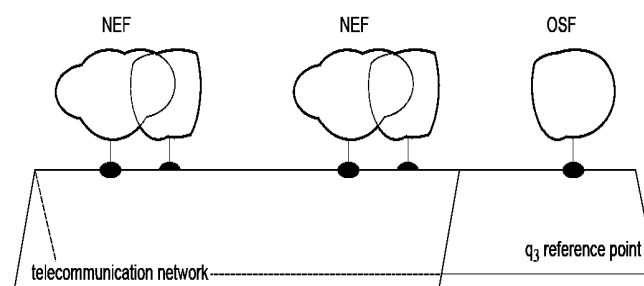


Fig. 6: Relationship to TMN

Relationship to Internet

The Internet management standards can be related to the functional reference model for protocol management in a similar way as the OSI management and the TMN standards. As example, the TCP transport protocol will be considered. The variables of TCP that can be managed by a remote-manager, are defined as part of MIB-II. This MIB (Management Information Base) not only defines the variables that belong to the transport layer, but also variables that belong to some other layers. The structure of MIB's is defined by SMI. Therefore it is assumed that SMI must be the common element of the transport layer entity and the manager entity (Figure 7).

The most interesting thing in the proposed model is, that SNMP is not shown as the protocol between managed and managing entity, but as part of their underlying service. This is because an important part of SNMP deals with functions like the Basic Encoding Rules, which should be considered as general transfer functions and not as management specific functions.

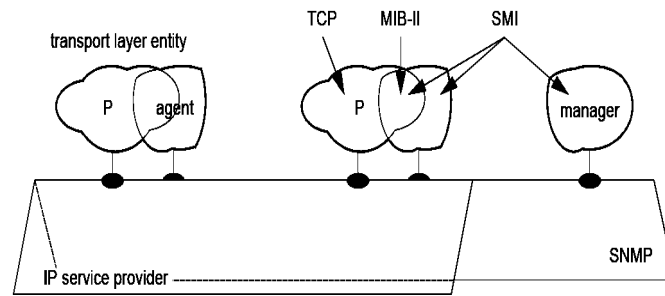


Fig. 7: Relationship to Internet management

IV. ADVANTAGES AND FUTURE WORKS

As opposed to other management approaches, this work proposes to model management functions in conjunction with primary functions. An important advantage of such approach, is that also the relationship between both kinds of functions may be modeled. As a result, it becomes possible to determinate the effect of management upon the primary functions. The models as presented in this work can thus be used to construct simulation tools that help managers to predict the effect of managed operations.

The most important advantage of the models, proposed here, is that the models are very similar according to the management standards and it is possible to implement common modeling approaches, techniques and tools for all types of networks.

Today there is a great demand of simulation tools. This demand increases through the years and it may be expected that it will increase in the future. For the network managers, such tools may be helpful allowing them to simulate management actions in advance.

Many of the current simulation tools are unique for specific types of networks. Their development is expensive and their maintenance requires a lot of effort. The models as presented in this work can be in principle used for development of automated tools, independent of the network type (Figure 8).

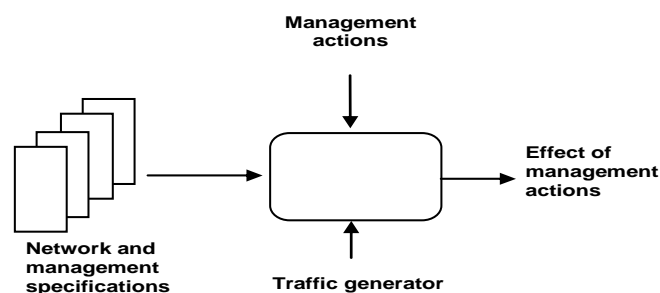


Fig. 8: Model of the simulation tool

Such automatic approach may implement the proposed protocol specifications of both primary and management functions, as developed during the design phase. These

specifications should be written in a formal language and are read by a general purpose simulation tool. This simulation tool can basically be the same as the ones used for the simulation of normal network protocols. Because management operations will be indicated during the operational phase, it will be possible to prolong the use of such simulation tools up to the operational phase.

Future works in this field may include development of appropriate simulation tools using object oriented approach – such as UML (Unified Modeling Language) and RUP (Rational Unified Process). The object oriented approach gets near to the approach proposed in this work. This may lead to creation of unified simulation tools which will not depend on the network type, on the management process and on the technology used.

V. CONCLUSIONS

There are several parts of OSI, TMN and Internet management that can be related to the functional model for protocol management proposed in this work. The discussion above according these relationships may be useful for the following important reasons:

- Current work on management can be placed in a better framework. As a result, the understanding of network management may be improved;
- By using existing parts, the applicability of the functional model for protocol management can be demonstrated without having to define yet another set of management protocols and services.

After the various relationships have been considered (Subsection IV), an advantage of the models proposed is presented. Some aspects for future works are given as well.

References:

- [1] ISO 7498: "Information Processing Systems – Open System Interconnection – Basic Reference Model", Geneva, 1984
- [2] ISO 7498-4: "Information Processing Systems – Open System Interconnection – Basic Reference Model – Part 4: Management Framework", Geneva, 1989
- [3] ISO 10040: "Information Processing Systems – Open System Interconnection – System Management Overview", Geneva, 1992
- [4] CCITT "Recommendation M.3010, Principles for a Telecommunications Management Network", Geneva 1992
- [5] RFC 1157: "Simple Network Management Protocol (SNMP)", Case J.D., Fedor M., Schoffstall M.L., Davin C., May 1990
- [6] Tsenov Al., T. Nikolov, "Alternative Architectures in the Network Management", Proceedings of the XL-th International Scientific Conference ICEST 2005, volume 2, pp. 593 - 596, Nish, Serbia and Montenegro, June. 29 - July. 1, 2005
- [7] Nikolov T., Al. Tsenov, "Integrated Service Models on Alternative Management Architectures", Proceedings of the XL-th International Scientific Conference ICEST 2005, volume 2, pp. 602 - 605, Nish, Serbia and Montenegro, June. 29 - July. 1, 2005
- [8] Tsenov Al., "Models Of Protocol And Element Management In Alternative Management Architectures", in the print, TELECOM 2005, Varna, Bulgaria, October 2005.

Authors:

Dr. Taschko Nikolov

Dr. Alexander Tsenov

Telecom Department at Technical University of Sofia,

"Kliment Ohridsky" Blvd 8,

1756 Sofia,

Phone: +359 2 965 2662

Fax:

E-mail: tan@tu-sofia.bg